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FUMIGANT-RESIDUAL INSECTICIDE MIXTURES FOR THE CONTROL
OF THE JAPANESE BEETLE

By R. D. Chisholm and L. Koblitsky, Division of Insecticide
Investigations, and A. C. Mason and L. W. Coles,
Division of Fruit Insect Investigations

Various fumigants applied as emulsions or solutions to turf or to fallow ground have been used successfully for the control of immature stages of the Japanese beetle (*Popillia japonica* Newm.). These include carbon disulfide (4), ethylene dichloride (1,7), and mixtures of ethylene dibromide and ethylene dichloride (2,6). Although these compounds are effective against populations present in the soil at the time of application, they are considered to be of no value in preventing reinfestation. Residual insecticides, such as DDT (5) or lead arsenate (3), applied either as sprays or in dry mixtures, have been used for this purpose. The toxic effect of such compounds is influenced by a number of factors, including the distribution of the insecticide in the soil and the time of application in relation to the life cycle of the insect. For this reason a considerable period may intervene between the application of a residual insecticide and the death of the insect. In some cases this period may be long enough to result in serious damage to valuable turf or to allow the survival of enough of the population to permit extension of the infestation to adjacent untreated areas. Mixtures which combine an immediate effect of ethylene dibromide-ethylene dichloride mixtures with a residual effect of DDT or lead arsenate are described in this paper.

A fumigant-DDT mixture was prepared to contain, in proportions by weight, 17.5 percent of ethylene dibromide, 62.5 percent of ethylene dichloride, 17.5 percent of DDT, and 2.5 percent of Tween 20 (a polyoxyalkylene derivative of sorbitan monolaurate). Since the ingredients are soluble or miscible in these proportions, the mixture can be prepared by conventional methods. It contains ethylene dibromide and DDT at the rate of 2 pounds of each per gallon and is readily emulsified in water with the aid of mechanical agitation. It was used at the rate of 10 ml. in 1 quart of water, and applied by sprinkling onto 1-square-yard plots. This rate is approximately equivalent to 12.5 gallons of mixture in 1,200 gallons of water and results in the application of 25 pounds of ethylene dibromide and 25 pounds of DDT per acre. A similar mixture, except that half the ethylene dibromide was replaced with ethylene dichloride, was also diluted at the same rate.

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The applications were made in the spring of 1945, when grubs were feeding near the surface. Many of those collected 5 days after treatment with both mixtures were dead. Final observations showed that 98 to 100 percent of them had been killed by the first mixture and more than 95 percent by the second.

These results are in agreement with others obtained from the application of sprays that did not contain DDT. These sprays were prepared from the ethylene dibromide-ethylene dichloride mixture recently authorized under the Japanese beetle quarantine regulations (2) and contained the same amount of ethylene dibromide as the mixture containing DDT. Applications of the fumigant mixture were made in from 1 quart to 1 gallon of water per square yard (1,200-4,800 gallons per acre) and at soil temperatures as low as 40° F. In general, it was found that, as the volume of water increased, toxicity also increased but was slightly less at the low temperatures.

A fumigant-lead arsenate mixture was prepared by adding the ethylene dibromide-ethylene dichloride mixture (2) at the rate of 5 ml. per quart of water in which 47 grams of lead arsenate was dispersed. The spray was applied to 1-yard-square plots. This is equivalent to a dosage of about 12.5 pounds of ethylene dibromide, 500 pounds of lead arsenate (an amount commonly used in the Japanese beetle control program), and 1,200 gallons of water per acre. This treatment was immediately followed by a second application of the same amount of water to wash the lead arsenate from the grass. Larval mortality was more than 95 percent in all plots treated.

The tests with fumigant-residual insecticide mixtures have not been sufficiently extensive to justify the establishment of recommendations for their use. However, these preliminary results are promising enough to suggest that such mixtures will be of value where immediate control of larvae is important. The cost of the fumigant required for the application of 25 pounds of ethylene dibromide per acre is about \$20. The fumigant-DDT mixture may be unique in that the fumigant is both an active ingredient and a vehicle for the DDT. The presence of the residual insecticide in the spray apparently does not reduce the effectiveness of the fumigant. Whether the fumigant affects the toxicity of the residual insecticide is being studied but has not been determined.

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